Estimation of the dust aerosol shortwave direct forcing over land based on an equi-albedo method from satellite measurements

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It is important but difficult to measure the shortwave radiative forcing of the dust aerosols over land from satellite observed radiance, because the inhomogeneous surface albedo varies in a large dynamic range [1,2]. In this study, we proposed a satellite-based equi-albedo method to derive the dust aerosol shortwave direct forcing over land. In the method, an equal radiance at the top of atmosphere (TOA) was assumed for the region with the similar surface albedo and the similar solar zenith angle. The aerosol optical depth (AOD) from moderate resolution imaging spectroradiometer (MODIS) and the shortwave radiance product from Clouds and Earth's Radiant Energy System (CERES) were used to derive the dust aerosol radiative forcing. The dust storm events outbroken on April 9 and April 24, 2010 in Taklimakan Desert were selected as study cases. The mean dust shortwave direct forcing efficiency is –35.08 Wm^{-2} per unit of dust AOD during the duststorm events. The results were validated with the calculated radiative forcing from MODIS AOD product by the radiative transfer model. It shows that the derived radiative forcing is well correlated with the simulated one. The mean difference is 10.57 and the standard deviation (STD) is 1.35. Moreover, uncertainty has been estimated. The regional mean directed radiative forcing due to dust are -28.98 ± 7.99 Wm^{-2} and -35.76 ± 10.61 Wm^{-2} of these two cases directly from satellite observations. Through comparing the results with previous studies [3,4] and SBDART simulations, indicates that the proposed method is reliable and effective, which can be used to estimate the shortwave direct radiative forcing of the dust storm event.

References

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